3D-NEWTON

TRAINING SOLUTION
Surgical bio-skills laboratories

SYMS & HANMED

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Low back pain

- ✓ One of the most common health problem all over the world.
- ✓ 80% of people will suffer at least one disabling episode of low back pain during their lives (Norris, 2008).

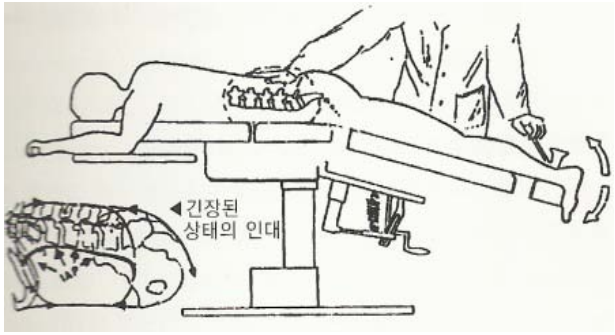
Devices for low back pain

Traction

- ✓Separation of the intervertebral motion segment and pain release (Krause et al., 2000)
- ✓ It is unclear the intensity and duration according to severity of low back pain

Devices for low back pain

Chiropractic table

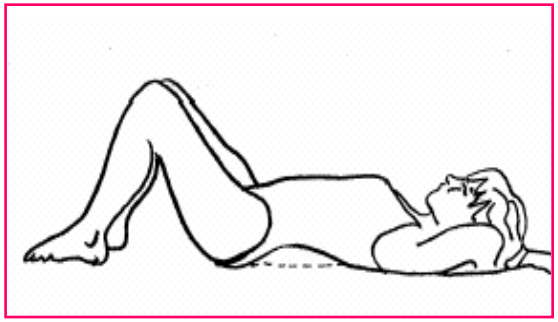


- ✓ Distraction and mobility of lumbar spine.
- ✓ It is possible to induce lumbar instability.

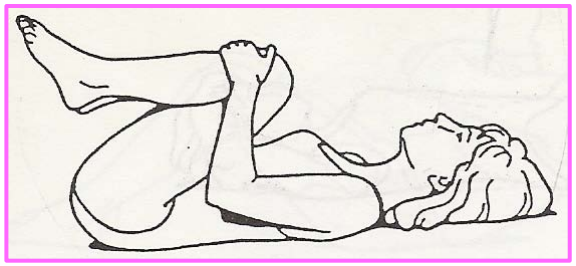
Exercise for low back pain

Williams' exercise

Williams' Exercise 1

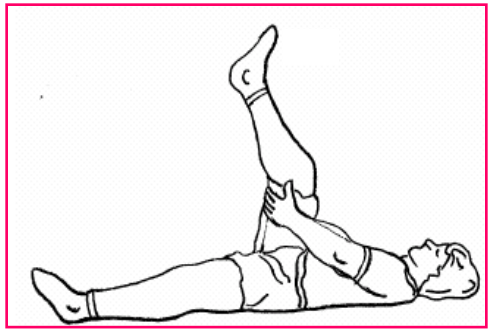


Williams' Exercise 3

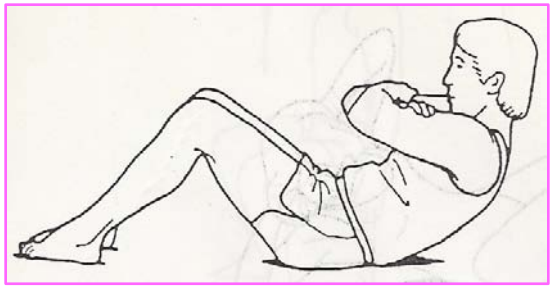


Williams' Exercise 6

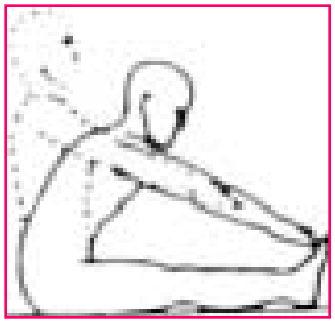
Williams' Exercise 2



Williams' Exercise 4

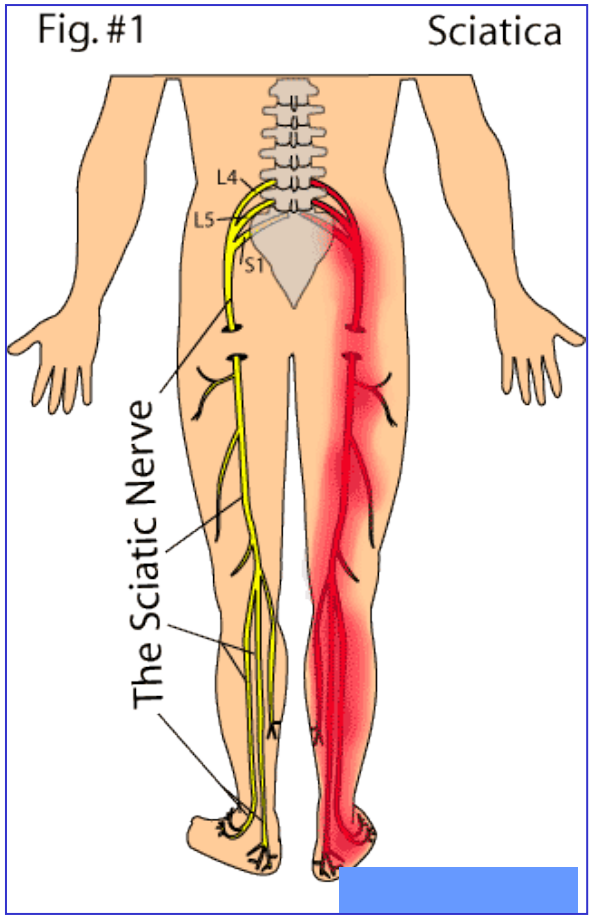


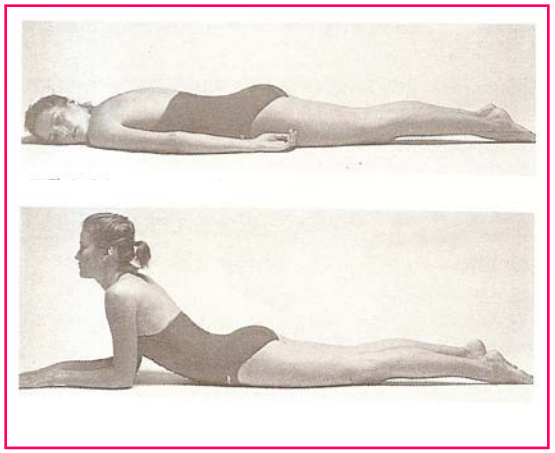
Williams' Exercise 5

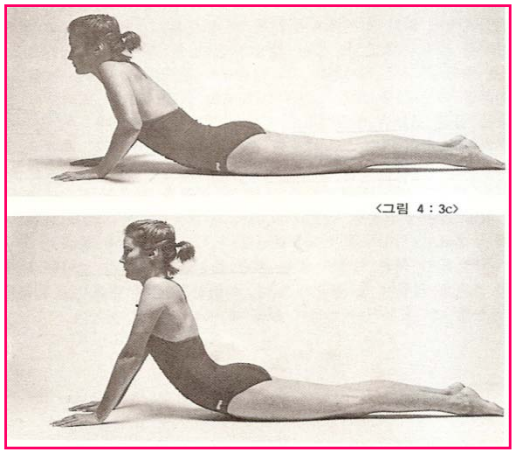


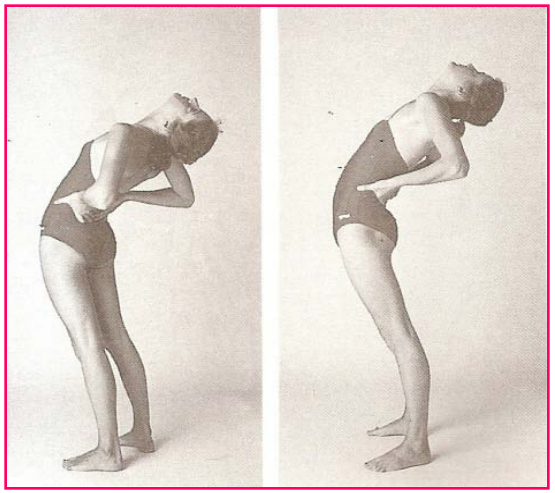
Exercise for low back pain

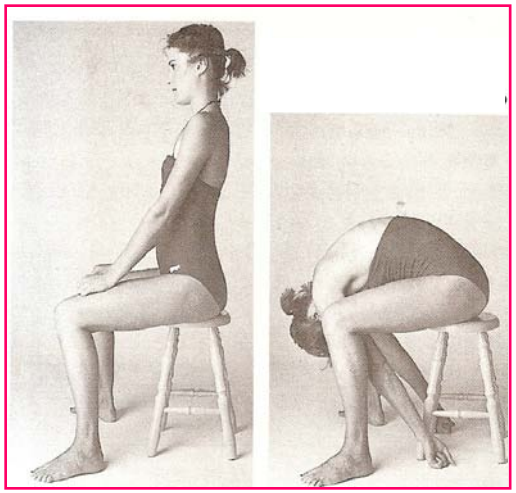
McKenzie's exercise











Strengthening of trunk muscles

Lumbopelvic stability is influenced by trunk muscles (global muscles & local muscles).

Trunk instability could induce low back pain.

Strengthening of lumbopelvic muscle is important for not only treating low back pain but also preventing low back pain.

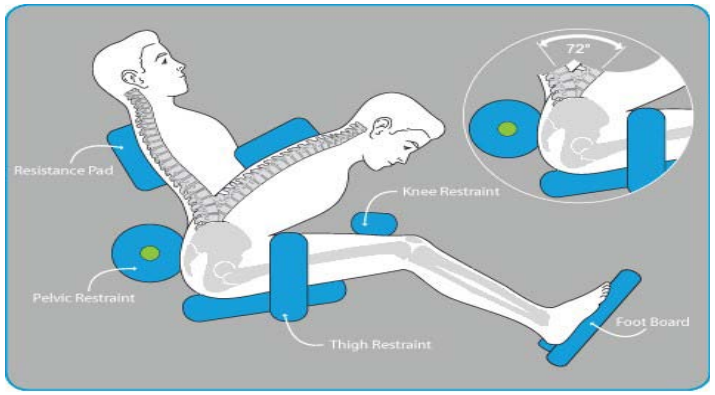
Strengthening of trunk muscles

Devices with unstable condition

- ✓ High cost-effectiveness & convenient application
- ✓ It could not acquire quantitative outcome of exercises.

Strengthening of trunk muscles

Isokinetic device



- ✓ Strengthening of back muscles with various intensity level.
- ✓ it is difficult to strengthen deep muscles of trunk.

Strengthening of trunk muscles

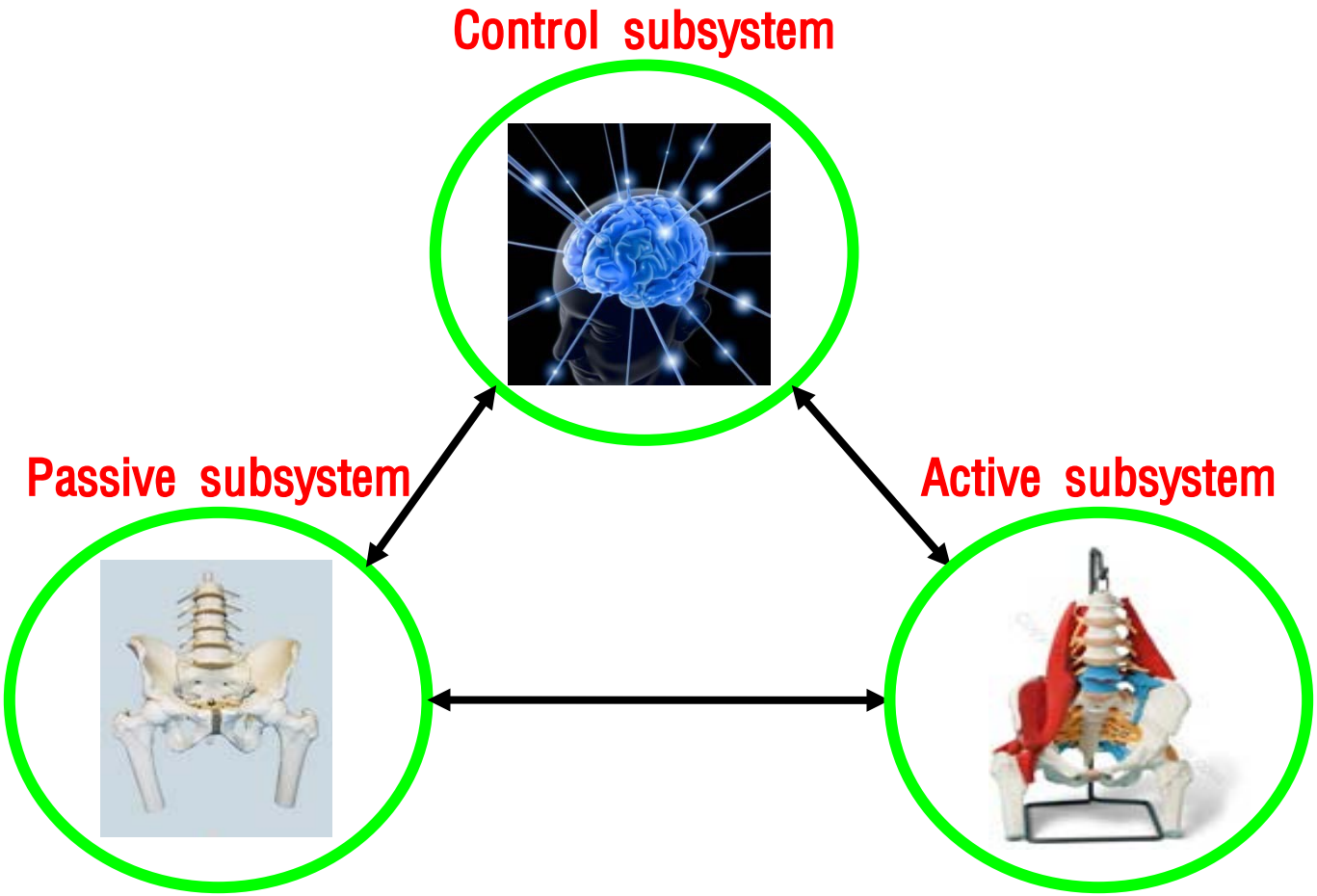
3-D CENTAUR

- ✓ Recently, strengthening of trunk muscles using gravity force is suggested as a new exercise protocol for low back patients
- ✓ However, it did not provide biofeedback for correcting postural alignment

Comparison of Technologies of 3D Spatial Rotators

Name of Model	3D-CENTAUR	SPACE CURL /Germany
Equipments **Display with Spatial Rotator Function**	 Window to identify movement	 
Patient Diagnosis **Bio Feedback** **Automatic sensor**	 - No feedback sensor - Objective data not available - Verification of equipment, not on the patient	**3D exercise-unit for posture training and stabilizing muscles an etc…**
Differential Technology	**- No patient monitoring function** **- Subjective data of curers** **- Subjective sthenometry** **- Unilateral adaption on the device**	**- Manual** **- Therapist can not treat as intended** **- Possible damage caused by sudden movement** **- Posture and muscular endurance can not measure**

What is the lumbopelvic stability ?



- ✓ Panjabi (1992) theorized that spine stability is dependent on three subsystem : passive (spinal column), active (spinal muscles), and control (neural control) subsystems.

Active subsystem

Active subsystem

Global mobilizer

Retus abdominis

External oblique abdominis – lateral fiber

Erector spinae

Global stabilizer

Internal abdominal oblique

External oblique abdominis – medial fiber

Local stabilizer

Transverse abdominis

Multifius

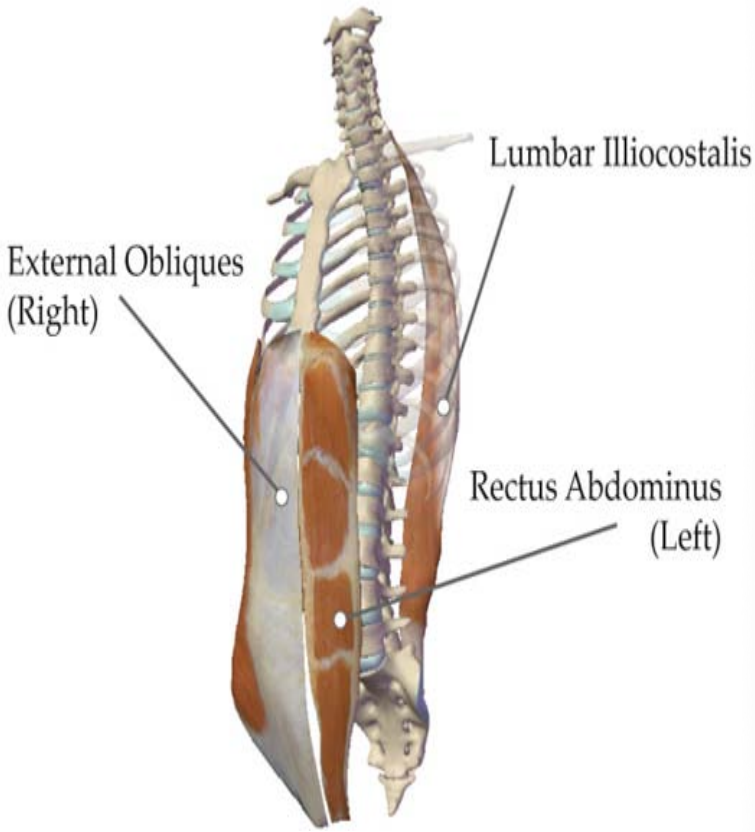
Active subsystem

Local muscles

- ✓ Multifidus, transverse abdominis, pelvic floor muscle
- ✓ Deepest layer muscles that originate and insert segmentally
- ✓ Control and maintain the neutral spinal curvature (Bergmark, 1989)

Active subsystem

Global muscles



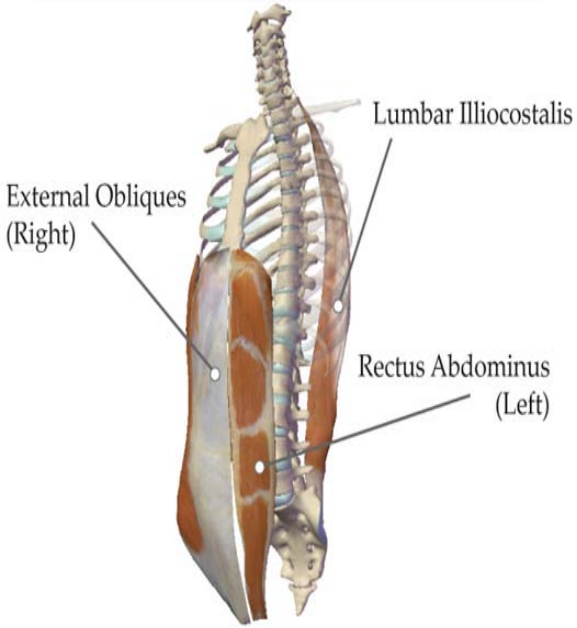
- ✓ Rectus abdominis,
  External oblique abdominis,
  Internal oblique abdominis,
  Erector spinae
- ✓ Superficial or outer layer of muscles lacking segmental vertebral insertions
- ✓ Insert or originate on the spine or pelvis (non-segmentally)
- ✓ Movement with stability (Bergmark, 1989; Gibbons and Comerford, 2001)

Active subsystem

Local muscles

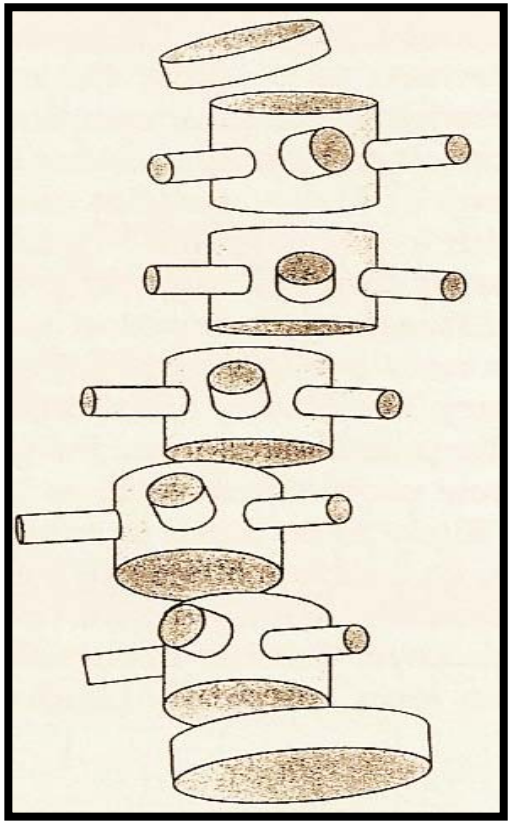
+

Global muscles

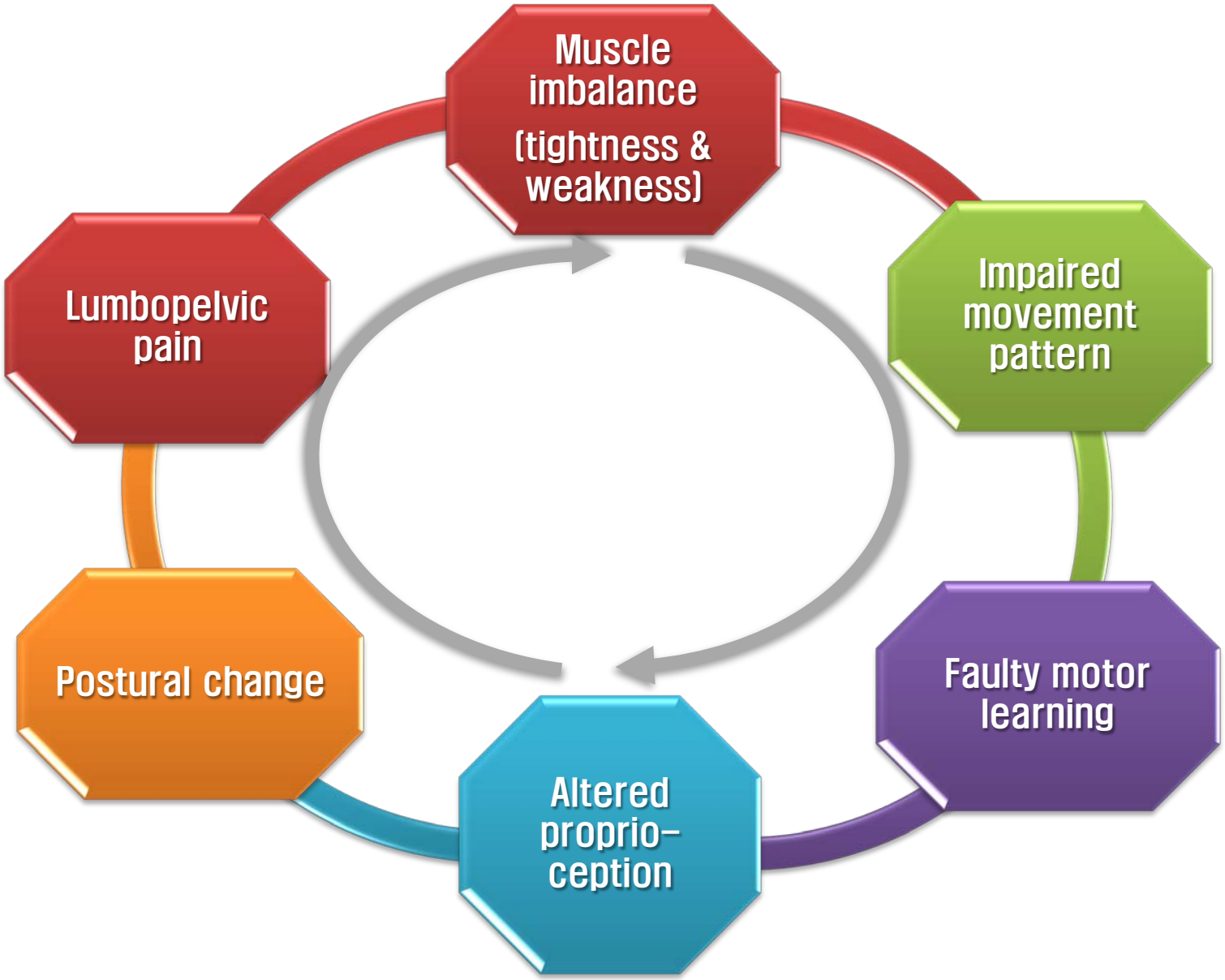


- ✓ **Active subsystem provides segmental stability and produce movement with stability (Gibbons & Comerford, 2001)**
- ✓ **Strengthening of local & global muscles ⇒ Increase in lumbopelvic stability**

The need for lumbopelvic stability

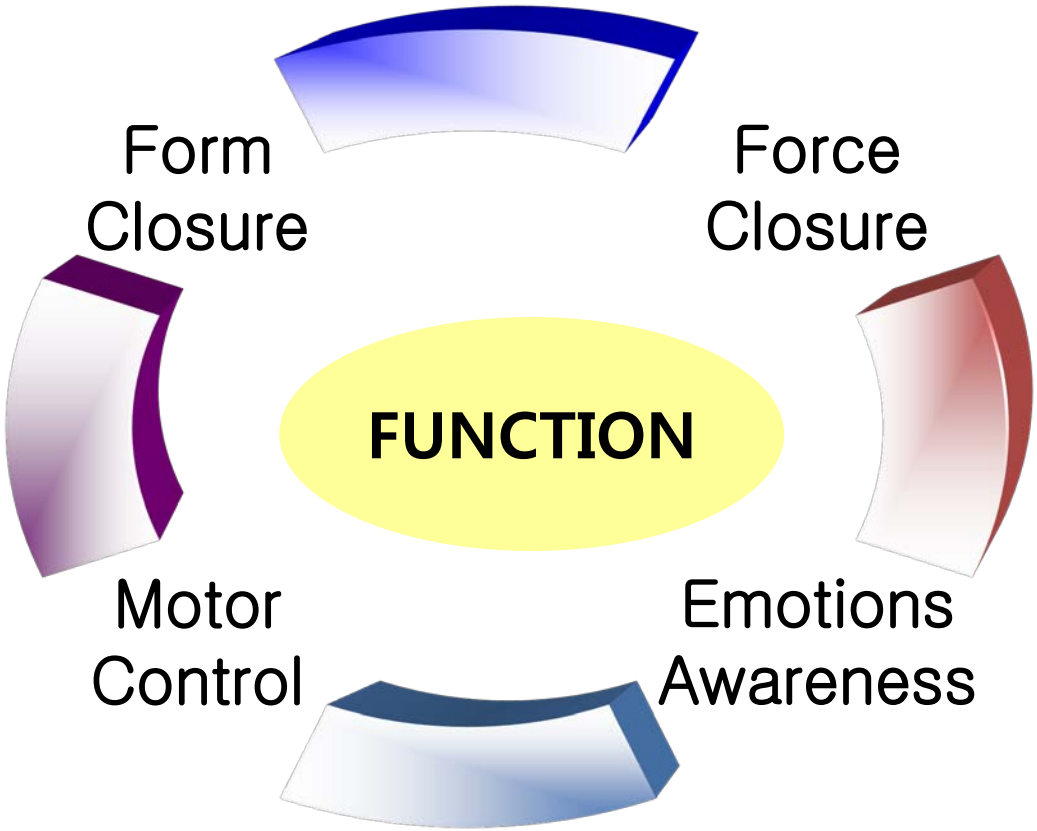


- ✓ Spine = multi-segmental joints
- ✓ The spine is inherently unstable and is dependent on the contribution of muscles in addition to the passive elements of the spine. (Panjabi 1992)
- ✓ **To maintain optimal spinal alignment, lumbopelvic stabilization is needed.**



✓ **Musculoskeletal pain cycle by Lund et al. (1991)**

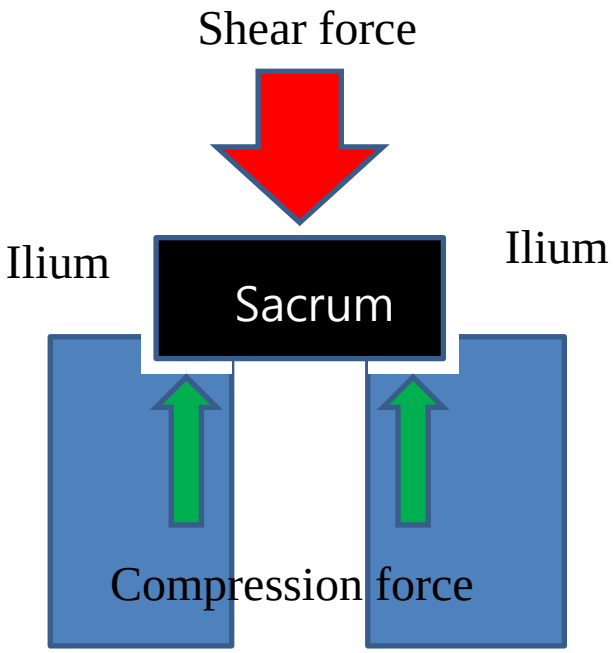
The integrated model for lumbopelvic function



✓ **The integrated model for lumbopelvic function (Lee & Vleeming, 1998)**

The integrated model for lumbopelvic function

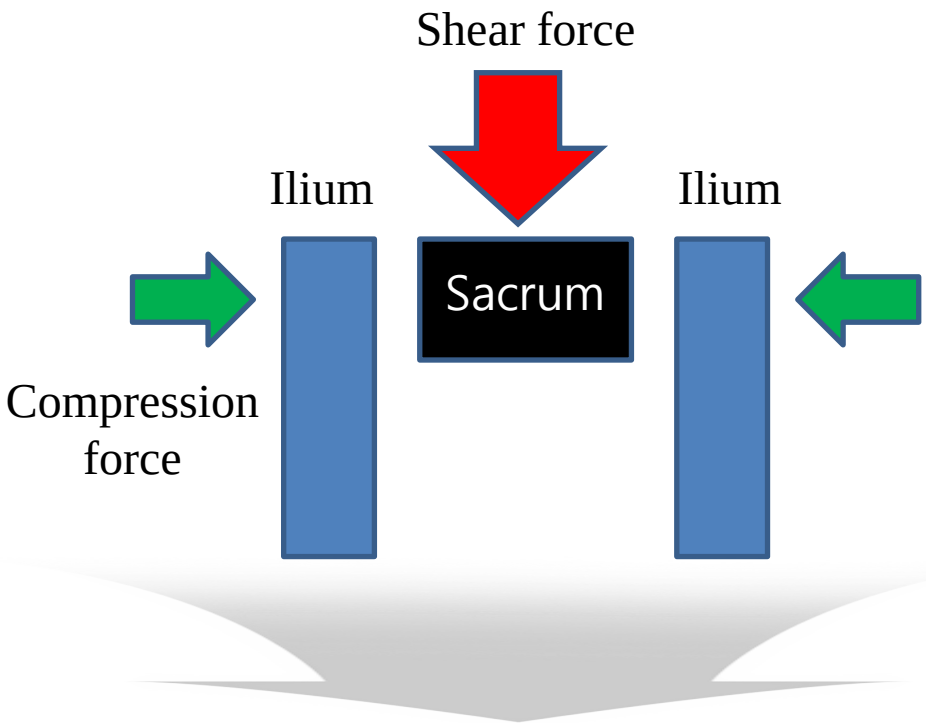
Form closure



- ✓ Joint, bones, ligaments
- ✓ A stable situation where no extra forces are needed to maintain the state of the system, given the actual load distribution (Snijders et al. 1993)

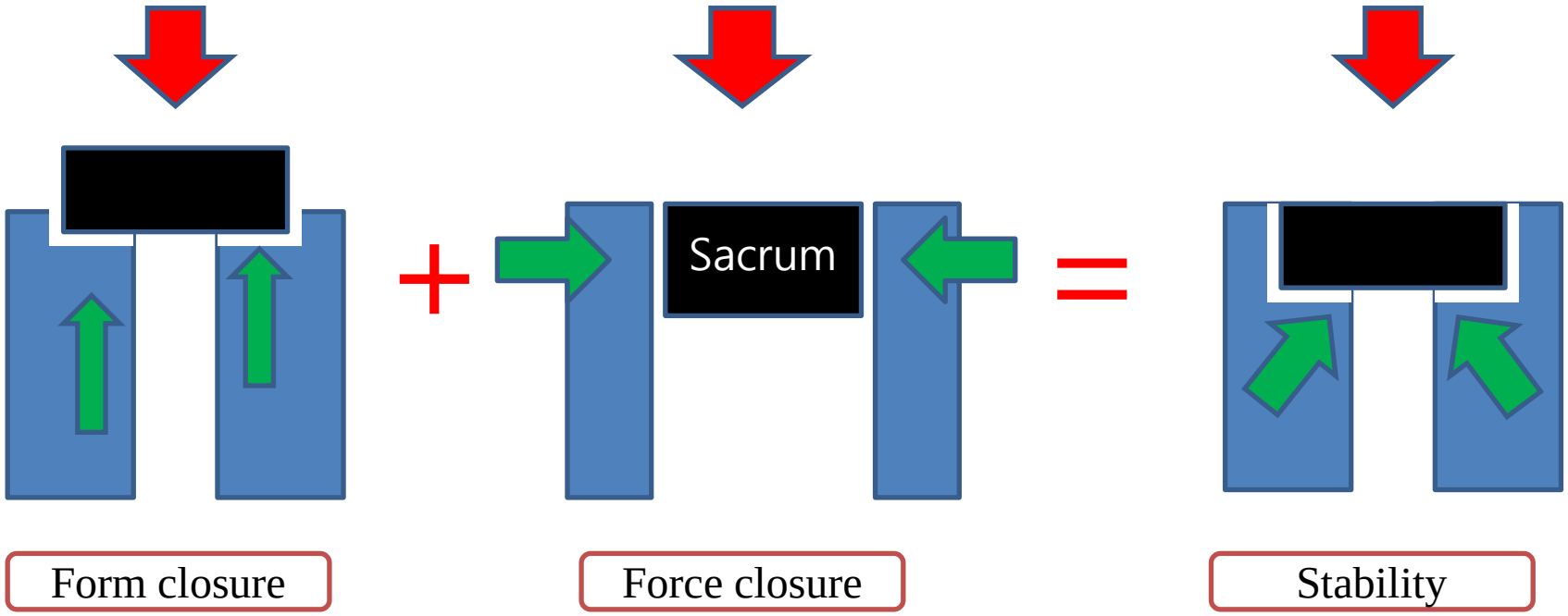
The integrated model for lumbopelvic function

Force closure



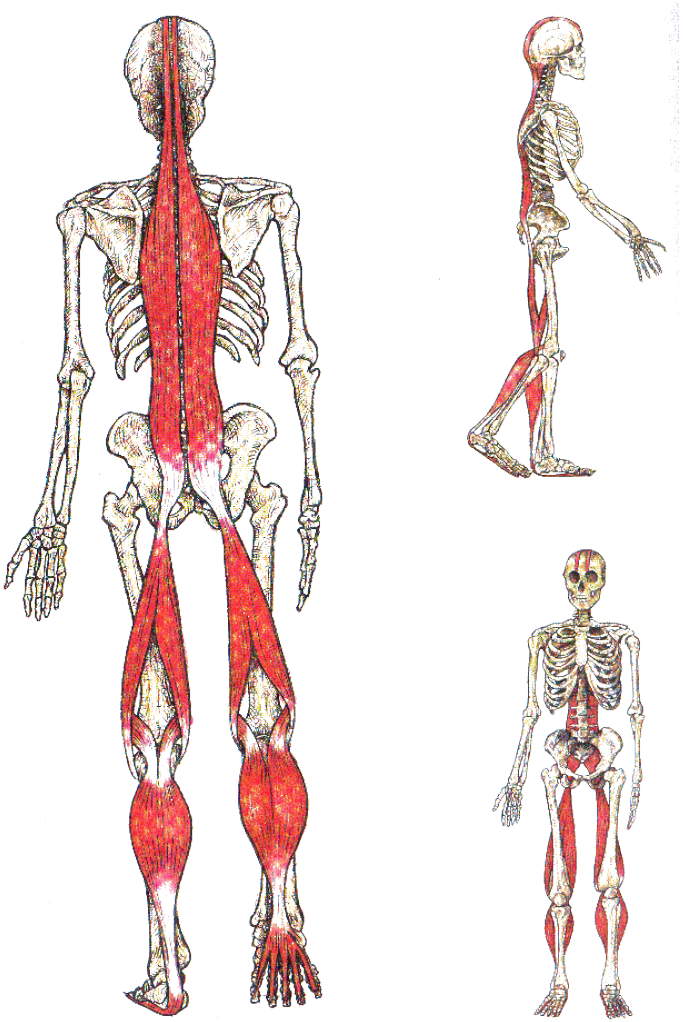
- ✓ Muscles, fascia
- ✓ Transverse abdominis, internal oblique abdominis, multifidus, pelvic floor muscles
- ✓ Extra forces are needed for lumbopelvic stability (Snijders et al., 1993)

The integrated model for lumbopelvic function



Gravity force

Anti-gravity muscles



- ✓ Tonic muscles or postural muscles
- ✓ Mainly extensor of the knees, hips, and back
- ✓ Maintaining normal posture, as they resist the constant pull of gravity

Gravity force

Muscle activity & gravity force

- ✓ Antigravity muscles are activated when gravity force is applied as a resistance
- ✓ Multifidus is more activated than ilicostalis lumborum during trunk holding (Ng et al., 1997)
- ✓ EMG activity of trunk muscles increase with increasing trunk tilt angle (Anders et al., 2008)

Gravity force

3-D NEWTON

- ✓ 3-D NEWTON could use gravity force as a resistance.
- ✓ Multidirectional gravity force.
- ✓ Strengthening of back muscles as well as trunk muscles.

3D-NEWTON Ver2.7.9

Personal Info. | Test | User Protocol | Training | SetUp

Selected Personal Chart No. 2 Name 테스트 Personal No. 1234 Notice 2 Height Weight Remark

TOTAL TIME 10 MIN Protocol Name did3 ReSend

Step	BodyAngle	Speed	HoldTime	Aslope	A.Angle
1	0	1	10	30	0
2	45	1	10	30	On
3	90	1	10	30	On
4	135	1	6	30	On
5	180	1	5	30	On
6	0	1	10	20	On
7	-45	1	10	22	On
8	-90	1	10	22	On
9	-135	1	6	20	On
10	-180	1	5	20	On
11	0	1	10	17	On
12	45	1	10	17	On
13	90	1	7	17	On
14	-45	1	7	17	On
15	-90	1	7	17	On
16	0	1	7	0	On

Progress Control

Sensor Intensity

Auto Skip

Sensor Perception

Over Vibration

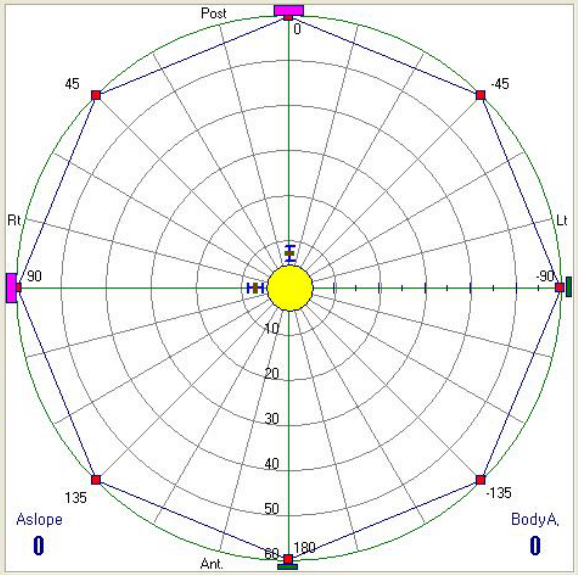
Vibration

Valid Check

Show Test Graph

Hide 2nd Screen

Preset Laser Position



Clear TrainingData

Apply

Clear Selection

Change Speed

Process Time

Start Time: None

Remain Time: 00:00:00

	Step1	Step2	Step3	Step4	Step5	Step6	Step7	Step8
Angle								
Momentum								
% / Max								
Slope								

Supply Percentage(%) 50 Apply View as Percent

Preparation Training

Move Immediately

Laser Control

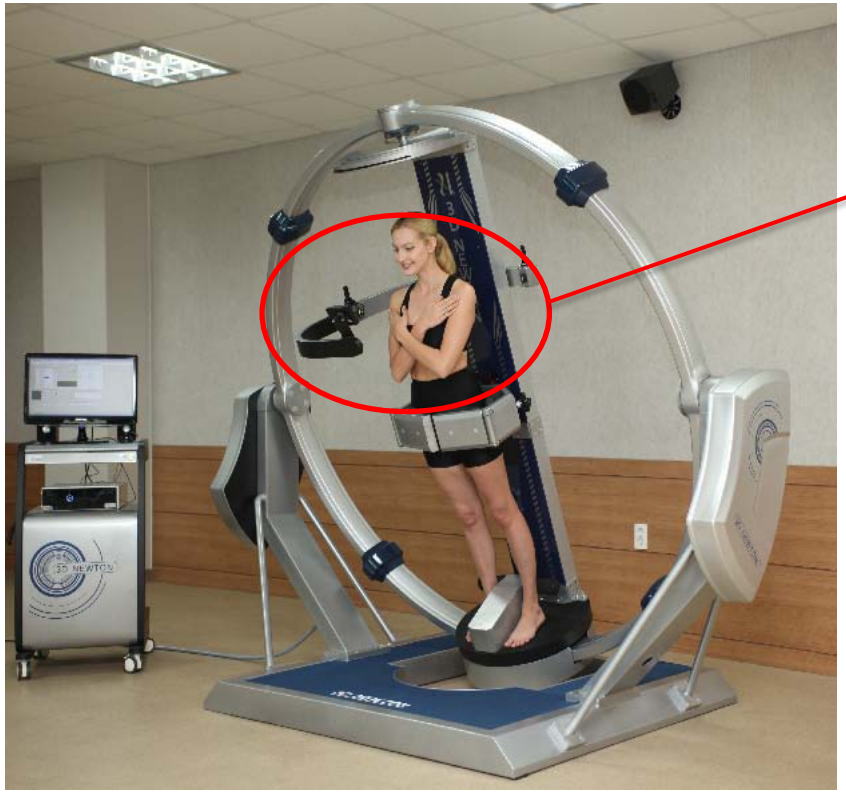
Pelvic Hoding

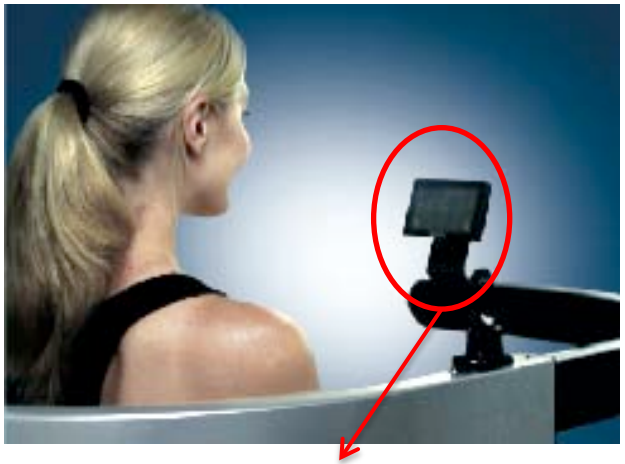
HOME | Training START | Training STOP | Skip to Next

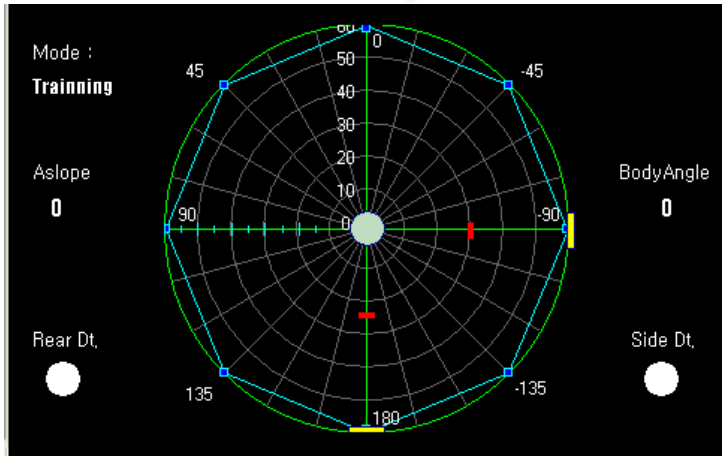
Interface Connected.

Biofeedback

3-D NEWTON







✓ **Self-monitoring of postural alignment using visual biofeedback**

Strengthening of trunk muscles

3-D NEWTON

Muscle activation ratio with and without visual biofeedback during whole body tilt

		With visual biofeedback	Without visual biofeedback	t	p
Forward tilt 40°	IO/RA	121.39±77.32	81.11±51.97	2.509	.026*
Backward tilt 40°	IO/RA	167.64±89.64	143.88±75.19	2.457	.029*

IO: Internal oblique abdominis, RA: Rectus abdominis, *p<.05.

(Kang et al., 2011)

3-D NEWTON

- User-friendly exercise device
- 3-D exercise for lumbopelvic stability
- Self-monitoring of postural alignment using visual biofeedback
- Objective measurement of outcome